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ORIGINAL ARTICLE

Open transgastric debridement and internal drainage of symptomatic non-infected walled-off pancreatic necrosis

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Abstract

Background: The best treatment options for walled-off pancreatic necrosis (WOPN) are not well defined. A retrospective study of patients treated for WOPN with transgastric debridement and internal drainage was undertaken.

Methods: Patients with symptomatic non-infected WOPN treated with open transgastric debridement and internal drainage were evaluated.

Results: In all, 51 patients underwent surgical management of necrotizing pancreatitis during the study period. Ten patients (19%) were treated with open transgastric debridement and internal drainage for symptomatic non-infected WOPN. The median patient age was 40 years, the most common aetiology for pancreatitis was biliary, the mean American Society of Anesthesiologists (ASA) score was 2 and the delay to surgery was 100 days. The operating time was 118 min, with a blood loss of 50cc. One patient required reoperation, three patients had morbidity and there were no mortalities. The only factor associated with post-operative morbidity was the presence of positive cultures ($P < 0.05$). The length of stay (LOS) after surgery was 8 days, at a median follow-up of 18 months, one patient had late complications related to the surgery and the procedure was successful in 90% of the patients.

Discussion: Open transgastric debridement with internal drainage of WOPN is safe and efficacious. Patients were clinically stable (no organ failure) and had a long delay in surgical intervention (100 days). In this select group of patients, the success, morbidity and mortality is similar to all reported minimally invasive techniques.

Keywords

pancreatic necrosis, surgery

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Introduction

The term walled-off pancreatic necrosis (WOPN) also referred to as post-necrosis pseudocyst, necroma or pancreatic sequestration was introduced at an American Gastroenterology Association symposium in 2006.[1] WOPN represents the late stages of an acute post-necrotic collection (APNC), which contains both fluid and necrotic material formed during the acute phase of severe acute pancreatitis. With time, APNC matures and a distinct wall develops between the areas of necrosis and the adjacent tissue. WOPN may be infected or sterile and diagnosis is established clinically and with the utilization of radiographic modalities. The most common indication for the treatment of pancreatic necrosis is suspected infection.[2,3] In addition, patients with non-infected WOPN may be persistently unwell or have recurrent disease manifesting with pain, fever, feeding intolerance and poor quality of life (QOL) necessitating surgical intervention.[4] The treatments vary from open debridement with external drainage to minimally invasive techniques with disparate outcomes.[5,6]

Reports describing the treatment of pancreatic necrosis have included a heterogenous group of patients and have not separated patients with symptomatic non-infected WOPN from those with suspected infection or infected WOPN.[3,4,7] The purpose of the present study was to evaluate a technique in the late management

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of symptomatic non-infected WOPN, open transgastric debridement and internal drainage. Open pseudocystogastrostomy is an accepted surgical intervention for simple pancreatic pseudocysts where it has been shown to be effective and associated with good outcomes.[8,9] Modifying this technique for treating WOPN has not been described. We report our experience with an emphasis on pre-operative patient characteristics, and peri-operative and long-term outcomes. We hypothesis that open transgastric debridement with internal drainage is an effective option associated with similar outcomes to other previously described techniques for the management of WOPN.

Methods

Patients admitted or referred for surgical management of pancreatic necrosis at the Foothills Medical Center and Peter Loughheed Medical Center between July 2003 and July 2009 were identified. These patients were identified from the medical records department. A retrospective chart review of patients managed with open surgery for pancreatic necrosis was undertaken. Patients with infected or suspected infection undergo open necrosectomy and drainage. Infected necrotic tissue is defined as a positive culture of pancreatic or peripancreatic necrotic tissue obtained by means of fine-needle aspiration or the presence of gas in the fluid collection on contrast-enhanced computed tomography (CT). Suspected infected necrosis is defined as persistent sepsis or progressive clinical deterioration despite maximal support in the intensive care unit (ICU), without documentation of infected necrosis. Patients with symptomatic non-infected pancreatic necrosis undergo transgastric debridement and internal drainage. Pancreatic necrosis was identified on CT, magnetic resonance imaging (MRI), contrast = enhanced ultrasound (US) and clinical criteria as defined by the Atlanta international symposium[1] as well as by the operative findings. Only patients with radiographic evidence of pancreatic necrosis followed by the development of a well-circumscribed pancreatic collection associated with necrosis and operative findings of pancreatic necrosis were included in the present study. Patients with predominantly fluid-filled pseudocysts and small areas of necrosis were not included in this study. Therefore, only patients with substantial areas of necrosis, >75% of the WOPN were considered for this surgical approach and all had areas of pancreatic necrosis at the time of surgery. Management of patients with substantial fluid components were often managed by endoscopic drainage. Patient demographics, aetiology of the pancreatitis, length of initial hospitalization, need for parenteral nutrition or nasojejunal tube feedings, previous interventions and indications and timing of surgery were obtained. Specific indications for therapy were clinically persistent pancreatitis or persistent unwellness as defined by Rattner.[10] Clinical manifestations of persistent unwellness included repeated admissions for mild pancreatitis with subjective complaints of abdominal pain requiring narcotics, failure to thrive and food intolerance. Surgical and post-surgical outcomes evaluated included size and location of WOPN, estimated blood loss, length of stay (LOS), need for reoperation, morbidity, mortality and presence of bacteria in the necrosis. In addition to other morbidities associated with abdominal surgery, specific complications included in the study were the subsequent need for percutaneous drain after operative intervention, enteric fistula and pancreatic fistula. Late complications were defined as complications occurring after 30 days.

Summary data are represented as medians (range). To determine prognostic variables for morbidity, the chi-square test was used with $P < 0.05$ being considered significant. Statistical analysis was performed using EXCEL (Microsoft Corp., Redmond, WA, USA).

Surgical technique

A limited upper midline incision was the standard incision. An anterior gastrotomy is made over the bulge of the WOPN. Using a large bore needle the area of WOPN is localized and a posterior gastrotomy made using electrocautery and the area of necrosis is entered. The posterior gastrotomy is enlarged and using a combination of blunt finger debridement, sponge sticks as well as irrigation and suction a complete debridement is achieved. In large areas of necrosis a 30-degree laparoscope has been utilized to visualize the entire cavity and to ensure adequate debridement. After completing the debridement, the cyst wall and posterior wall of the stomach is sutured to the inflammatory wall using interrupted 4.0 polydioxone (Ethicon Inc., Somerville, NJ, USA) sutures. The anterior gastrotomy is subsequently closed after nasogastric tube placement.

Results

Patient characteristics

During the study period, a total of 51 patients were treated for pancreatic necrosis. In all, 41 patients underwent an exploratory laparotomy with necrosectomy and closed drainage as described by Fernandez *et al.*[3] Ten patients (9.6 % of all patients) had a diagnosis of symptomatic non-infected WOPN and were treated with transgastric debridement and internal drainage. The median age was 40 years, 6 were female. The aetiology of the pancreatitis was biliary in six and alcoholic in four. The indication for surgery based on the clinical course was persist pancreatitis in four and recurrent in six patients. The patients with persistent pancreatitis all required prolonged hospitalization and were unwell with fevers and pain, whereas the patients with recurrent pancreatitis were often discharged after their episode of pancreatitis but had symptoms related to WOPN with the most common being pain requiring narcotic administration and failure to thrive. All but one patient had weight loss associated with pancreatitis (median weight loss of 25 lbs). No patients required ICU care at the time of surgery. The median time from presentation with pancreatitis to definitive surgical management was 100 days, and 4 patients had significant comorbidities at the time of surgical intervention. The mean American Society of Anesthesiologists (ASA) score was 2

Table 1 Patient characteristics

Patient	Age	Gender	Aetiology	Clinical course	Symptoms	Weight loss (lbs)	ICU stay	Time to surgery (days)	Comorbities
1	39	m	Alcohol	Recurrent	Early satiety	0	No	273	Smoker
2	42	f	Biliary	Persistent	Pain	10	No	40	No
3	79	f	Biliary	Recurrent	Pain	30	Yes	206	DM, HTN
4	51	m	Alcohol	Recurrent	Pain	50	Yes	184	CAD
5	29	f	Biliary	Recurrent	Pain	30	Yes	122	No
6	22	m	Alcohol	Persistent	Pain, FTT	30	Yes	77	DM, HTN
7	41	f	Biliary	Recurrent	Pain	20	No	90	No
8	36	f	Biliary	Persistent	Pain, FTT, fevers	40	No	110	No
9	51	m	Alcohol	Persistent	Pain, FTT, fevers	20	No	48	No
10	33	f	Biliary	Recurrent	Pain, FTT	10	No	88	DM

ICU, intensive care unit; FTT, failure to thrive; DM, diabetes mellitus; HTN, hypertension; CAD, coronary artery disease.

Table 2 WOPN characteristics

Patient	Size (cm)	Location	Gutter extension	Pre-operative intervention	Positive cultures at surgery	Splenic vein thrombosis
1	10.2	Body, tail	No	No	No	Yes
2	14.4	Body, tail	No	No	No	No
3	14.4	Body, tail	No	No	No	No
4	25	Body, tail	Yes	No	Yes	Yes
5	17.2	Complete	Yes	No	No	No
6	20	Complete	Yes	Endoscopic cystgastrostomy	Yes	Yes
7	12	Body, tail	No	EUS-guided drainage	Yes	No
8	12	Body	No	No	Yes	No
9	16.3	Body, head	Yes	No	No	Yes
10	14	Body, tail	No	No	No	No

EUS, endoscopic ultrasound.

(Table 1). As a result of the fact that most patients were transferred into our institution or referred after the initial episode of pancreatitis we could not obtain a Ranson or APACHE score.

WOPN characteristics

WOPN characteristics are shown in Table 2. The median maximal diameter of WOPN on CT scan was 14 cm. In six patients, WOPN was located in the body and tail of the pancreas, two involved the entire pancreas, one the body and head and one the body only. In four patients there was extension to the paracolic gutters. Two patients had prior endoscopic attempts at treating the area of pancreatic necrosis: one patient had had endoscopic cystogastrostomy without resolution of the symptoms and the other had had endoscopic ultrasound (EUS)-guided tube drainage with similar outcomes. Bacterial cultures taken in the operating room grew bacteria and/or fungi in four patients, with *enterococcus sp.* being the most common. Splenic vein thrombosis was present in half of the cases, but there was no clinical or radiographic evidence of gastric varices in any patient.

Peri-operative outcome

All patients underwent successful transgastric debridement without mortality and six of the patients also underwent a cholecystectomy (Table 3). The operative time was 118 (60–270) min and the estimated blood loss was 50 ml (50–750). No patient required post-operative ICU admission and the median LOS was 8 days. Three patients had early post-operative morbidity involving wound infection treated with local debridement. One patient required reoperation for further debridement of the WOPN via a retroperitoneal incision and this was complicated by a gastric fistula. One patient developed a symptomatic intra-abdominal fluid collection that resolved with percutaneous drainage. The only factor associated with the development of early post-operative morbidity was positive cavity cultures at debridement, $P < 0.05$. At a mean follow-up of 18 months, two patients experienced late complications: development of a recurrent abscess in the retroperitoneum related to the gastric fistula and recurrent pseudocyst 3 years after resolution of WOPN associated with ongoing alcohol abuse and chronic pancreatitis. Pre-operative

symptoms resolved in 90% of the patients. Eight patients had post-perative CTs at a median of 2.5 months documenting resolution of their WOPN (Fig. 1).

Discussion

WOPN occurs in the late stage of necrotizing pancreatitis, it is a distinct entity from a pseudocyst and treatment requires some form of debridement unlike a pseudocyst where a drainage procedure is often adequate.[11] A conservative approach to patients with severe acute pancreatitis including a delay in surgery of up to 4 weeks has been shown to be advantageous,[2,3] and this has resulted in fewer patients with necrotizing pancreatitis undergoing early surgery leading to an increased incidence in patients presenting with WOPN.[12,13] Recently, a randomized trial demonstrated that by utilizing a step-up approach for patients with suspicion of infection or infected pancreatic necrosis, 35% of patients did not require a subsequent necrosectomy after initial management with percutaneous drainage.[14] In our patient population, 81% of patients referred for surgical management of pancreatic necrosis underwent laparotomy and necrosectomy with closed drainage for infection or suspected infection. The long-term clinical course of patients managed without necrosectomy or by percutaneous drainage only is unknown and it is unclear how many will become symptomatic and require an intervention. However, it is clear that many patients with necrotizing pancreatitis have a poor QOL even after non-surgical management and are persistently unwell with repeated admissions or visits to the physician with failure to thrive manifested primarily by poor oral intake and pain.[15,16] Some of these patients may have persistent WOPN without systemic or radiologic signs of infection. In all, 19% of all patients referred for surgical management of pancreatic necrosis at our institution comprised this group of stable elective patients with long delays before intervention and without evidence of organ failure or suspected infection. Treatment of symptomatic-infected WOPN involves open debridement with external drainage and recently several centres have reported new minimally invasive treatment approaches that according to Windsor *et al.*[17] can be classified by the access route (transperitoneal, retroperitoneal, transgastric) and by the type of scope used (endoscope, laparoscope or nephroscope).

Our experience with open transgastric debridement and internal drainage in a well-selected group of patients with symptomatic non-infected WOPN has proven to be effective and highly successful in the management of this challenging medical condition. It appears to be similar to other techniques with acceptable morbidity and LOS with long-term success of 90% at a median follow-up of 18 months. There are several technical limitations to the utilization of this technique: lack of apposition of the gastric wall to the WOPN could complicate the operation and lead to a gastric fistula, inadequate necrosectomy at the initial operation could require subsequent drainage via a different approach and lead to a gastric fistula, which occurred in one of our patients causing multiple retroperitoneal abscess related to this issue. Therefore in patients with extensive paracolic gutter extension this technique should only be used in those instances where a com-

Table 3 Peri-operative data and treatment outcomes

Operative time (minutes)	118 (60–270)
Estimated blood loss (mls)	150 (50–750)
Cholecystectomy	6/10
ICU stay	0
Length of stay	8.8 (6–16)
Complications	3 patients (33%)
Re-operation	1 patient (10%)
Late complications	2 patients (20%)
Mortality	0
Median follow-up (months)	18
Symptom resolution	9/10

ICU, intensive care unit.

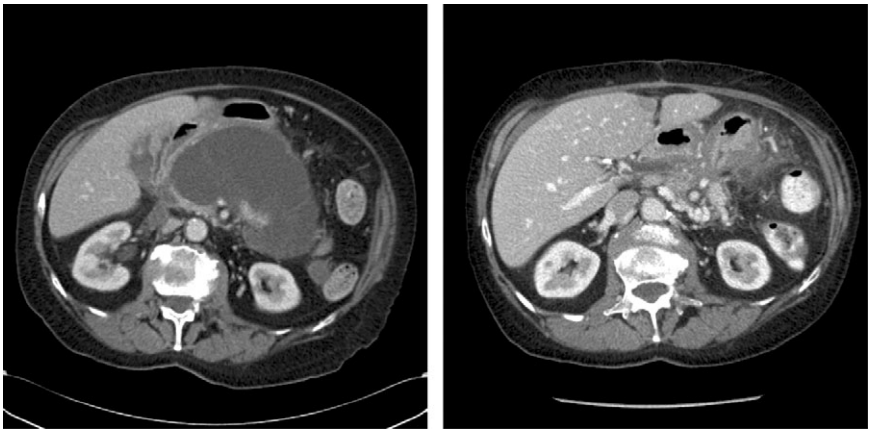

Figure 1 Pre-operative and post-operative computed tomography (CT) scan showing resolution of walled-off pancreatic necrosis (WOPN)

plete debridement can be achieved at the time of initial operation. Incomplete debridement assessed intra-operatively mandates external drainage after closure of the gastrotomy. One of the concerns of internally debriding and draining WOPN is that it could lead to continuous retroperitoneal contamination. However, a complete debridement should prevent ongoing retroperitoneal sepsis.

Operative management of pancreatic necrosis involves open debridement followed by closed packing and/or drainage. However, morbidity and mortality associated with this technique is substantial.[3,13,18] The reported early mortality associated with open debridement ranges from 3.7%–39%[3,19] and an additional late mortality of 15%.[6] Open debridement is associated with an incidence of a pancreatico-cutaneous fistula of up to 53% and enteral fistulae of up to 16%.[3,19] Laparoscopic or hybrid techniques that utilize wide external drainage also have high rates of fistulae formation. Parekh *et al*. reported on 19 patients who underwent a hand-assisted laparoscopic necrosectomy with a mortality rate of 10%, morbidity of 28% and need for laparotomy in 15%. The pancreatic fistula rate in that study was 67% determined by drain amylase levels[20] Most of the reports on the management of WOPN with open necrosectomy have included a large majority of patients with infected pancreatic necrosis (54–72%) which was the primary indication for surgical intervention.[3,6,21] This group of patients is a distinct group, different from our patient population and therefore direct comparison is not possible.

Retroperitoneal necrosectomy uses a small retroperitoneal incision or reliance on a pre-operatively placed drain to guide the placement of the incision. Dilation of the drain tract enables the placement of a scope that can be used for debridement. In a recent review of 141 patients treated with retroperitoneal necrosectomy, the mortality was 16%, morbidity was 41%, 2–8 procedures per patient were required and there was a 13% need for subsequent laparotomy.[5,22,23] In the randomized trial where retroperitoneal minimally invasive necrosectomy was used as the next step up after percutaneous drainage, the median number of procedures was one per patient.[14]

Endoscopic management of WOPN has become an option in some specialized centres. Simple endoscopic drainage of WOPN has been found to be ineffective when compared with endoscopic necrosectomy (45% vs. 88%) and simple drainage required more procedures and the LOS was longer.[11] Therefore, some form of necrosectomy is recommended. The endoscopic necrosectomy technique involves creation of a transgastric or transduodenal pseudocyst tract that is subsequently dilated to allow for debridement. A minimum of three procedures is required with a hospital stay of 5–13 days. These endoscopic techniques are associated with major morbidity of 20%, mortality of 5% and the need for laparotomy in 0–23% of patients.[4,5,11,24]

The primary advantage of transgastric drainage compared with open, laparoscopic debridement or retroperitoneal debridements, which all utilize external drainage, is the reduction in the pancreatic fistula rate which can be associated with significant morbidity and mortality.[25] Some reports recommend that a pre-operative endoscopic retrograde cholangiopancreatography (ERCP) would better define the group of patients with pancreatic duct injury and therefore favour internal drainage.[26,27] The disadvantage of retroperitoneal necrosectomy is that it often requires multiple procedures for a complete necresectomy compared with one definitive procedure for the transgastric technique.[22,23,28,29] Open transgastric debridement and internal drainage appears to have similar morbidity, reduced LOS and no mortality compared with the endoscopic management of WOPN with the advantage of requiring fewer procedures and a reduced length of hospitalization.[4,28] Several factors have been found to be predictive of failure in the endoscopic management of WOPN: extension into the paracolic gutters, size >15 cm and the presence of diabetes mellitus.[4] Given the limited size of the present study, factors predictive of failure could not be identified. The patient with a poor outcome had all three of these factors. However, patients with one or two of these factors representing 40% of our patients were successfully treated with our technique. Additionally, this approach enables cholecystectomy to be performed at the time of initial surgery therefore negating the need for a second operation which may decrease hospitalization time and cost.

Limitations of the present study are that it is retrospective and includes a small number of patients with a short follow-up. Also a cost or a QOL analysis was not performed but are areas that need further elaboration. Most reports on the treatment of complications related to necrotizing pancreatitis have included a heterogeneous group of patients. The clinical spectrum of patients has ranged from septic patients with organ failure to stable patients with recurrent disease manifested by pain and/or failure to thrive. Therefore any direct comparison between different techniques is plagued by clinical heterogeneity.[14,20,30] Even although four of our patients had intra-operative cultures that were positive, two had prior instrumentation and the other two may be related to contamination as cultures were taken after the stomach was opened. None of our patients had clinical or radiographic signs and symptoms of infection pre-operatively.

The natural history of patients with symptomatic non-infected WOPN or patients who were managed without necrosectomy for suspected infected WOPN is unknown. Over time, patients may experience resolution of the necrosum and therefore not require intervention for symptoms. Longitudinal studies on these patients will determine the need for surgery. A definitive conclusion regarding this technique requires a larger prospective study which in addition to clinical resolution should also include a cost and QOL analysis as some of the outcome measures so as to determine the preferred approach for treating this group of patients. An effort should also be made to separate patients with symptomatic non-infected WOPN from those with suspected or infected pancreatic necrosis when reporting on techniques used in the management of WOPN because their outcomes are different. In a group of stable patients with persistent symptoms from non-

infected WOPN, remote from their episode of pancreatitis, open transgastric debridement and internal drainage is a reasonable surgical option and may be a useful option in centres without experience in minimally invasive techniques.

Conflicts of interest

None declared.

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